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Evaluation of Cowpea [*vigna unguiculata (l.) Walp.*] Cultivars using Morphological Indices

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Abstract: *Cowpea is a multipurpose crop and is a grain legume mainly for dry beans and green vegetables and also as forages, green manure and cover crop. It is cultivated for its seed (green or dried), pods and / or leaves, which are consumed in fresh form as green vegetable. In our study, we investigated of morphological characterizations of different plant part of seven cowpea cultivars. We characterized the leave, stem ,flower and seed of seven cultivars of cow pea. During this investigation we found that leaf variability flower variability pod variability seed variability were very much significant after this study it is concluded that the variability help in identifications of different cultivars of cow pea. The characters such as plant height, number of pods per plant and days to 50 per cent flowering cannot be referred as reliable trait for genotype identification because of effect of environment. Seed morphological characters like eye pattern, size and shape were also found helpful in characterization of cowpea in genotype identification programme. For which extensive studies are required. It has been possible to identify some of the genotypes based on one or few character which give clear classification in characterization in field condition for example, GC-121, FS-68 and Chirodi can be identified by hastate terminal leaflet shape and DCP-13, CPD-72, GC-121 and GC-27 by white flower.*

Key word: Genotype ,Cowpea, Vigna unguiculata, Cultivar, Crop & Variety.

Introduction

Cowpea [*Vigna unguiculata* (L.) Walp.] (2n=22) is one of the important pulse crops, which is used extensively in India, is used extensively in Indian vegetarian diet. It is an ancient crop probably domesticated during the Stone Age.. The seeds contain very high protein content, i.e., 23-29% with a potential upto 35%. It has the ability to fix atmospheric nitrogen which improves the poor soils by leaving a fixed amount of nitrogen deposit in the soil upto 60-70 kg/ha for succeeding crop (Steele, 1972 and Rachie, 1985).

Cowpea is a multipurpose crop and is a grain legume mainly for drybeans and green vegetables and also as forages, green manure and cover crop. It is cultivated for its seed (green or dried), pods and / or leaves, which are consumed in fresh form as green vegetable, while snacks and main meal dishes are prepared from the dried grain.

It is relatively drought tolerant and can grow in a wide range of soils and does well in acidic soil. Cowpea is cultivated on about 12.5 million hectares with an annual production of over 3 million tones and productivity of 240 kg/ha of grain at global level (Singh *et al*., 1997). Crop is mainly grown in central and penisular region, Uttar Pradesh, Punjab and Delhi but in Uttar Pradesh it is mainly used for seed and green fodder under irrigated and rainfed conditions. Cowpea is a hardy crop, capable of tolerate wide range of climatic conditions like scanty to high rainfall and high to low temperature, due to its indeterminate growth and leaves sensitivity towards dehydration (Sinclair and Ludlow, 1986). It also serves as an ideal crop for soil and water conservation because its ability to grow fast and cover the soil surface quickly (Tyagi et al., 2000).

It is well known that the difference between growing one variety and another may be the difference between a profit and a loss. In consequences, it is essential for the buyer to get the variety he asks for and not something else. Our ability to discriminate between and identify cultivars of agricultural and horticultural crops is thus fundamental to the operation of the modern seed trade. All sectors of the industry from breeders through the registration authorities, seed producers, seed certification and testing agencies, seed merchants, farmers, growers, grain merchants, processors and others benefits from varietal identification at some stage in their activity.

Even then by using morphological characters the genotypes can be distinguished from other genotypes, easily and inexpensively. In such situations, determination of purity of a variety might become a complicated task. For genotype identification chemical tests can be used as they are quick, simple and reproducible. The International organizations such as International Union for the Protection of Plant Varieties (UPOV), International Seed Testing Association (ISTA) and Association of Official Seed Analysts (AOSA) etc. have put emphasis on characterizatioof cultivars by field and

laboratory techniques as these give quick, reproducing and true picture of genotypes. Therefore, the present investigation was carried out.

Material and Methods

Plant materials

The seven genotypes of cowpea obtain form deferment institutions

All the seven genotypes were grown in a randomized block design (RBD), with three replications after pre sowing irrigation on July *Kharif* . Each genotype was accommodated in a single row of 4 meter length keeping 30 cm inter row spacing and 15 cm intra row spacing. All recommended package of practices were followed to raise a good crop.

Each genotypes used in present study and their sources FS -68 and Chirodi CCS HAU, Hisar, GC-121 ,GC-115,and GC -27, SADU, Gujarat,CPD-72 RAU. ARS. Durgapura, Rajasthan DCP-13 IARI, New Delhi

Morphological characters

Each morphological character 5 random representative plants in each replication were taken for recording the data of Qualitative and Quantitative characters of cow pea by using standard parameter .

Statistical analysis

The data recorded in the field were subjected to the statistical analysis.the data were analysed as per procedure describe by panse and sukhatme (1967)

Result

The present investigation related to the analysis of Morphological characters of seven genotypes of cowpea

Leaf characters

Leaf colour

Majority of the genotypes showed green and dark green colour . The detailed result has been given in table 1

Terminal leaflet shape

The leaves were observed visually for terminal leaflet shape. The genotypes were classified as hastate and ovate. The detailed result has been presented in the table 1.

Leaf apex

In the present study no variation was observed for leaf apex as all the genotypes showed acute leaf apex.

Leaf surface

The genotypes were classified as glabrous. The detail result has been depicted in Table 1.

Leaf margin

No variation was observed for leaf margin as all the genotypes showed wavy margin.

Table 1: Morphological Characters of leaf of cowpea genotypes

Genotype	Leaf colour	Terminal leaf let shape	Leaf apex	Leaf surface	Leaf margen
FS- 68	Green	Hastate	Acute leaflet	Glabraus	Wavi leaf margen
Chirodi	DarkGreen	Ovate	Acute leaflet	Glabraus	Wavi leaf margen
GC-121	Green	Hastate	Acute leaflet	Glabraus	Wavi leaf margen
GC-115	Green	Ovate	Acute leaflet	Glabraus	Wavi leaf margen
GC-27	Green	Ovate	Acute leaflet	Glabraus	Wavi leaf margen
CPD-72	DarkGreen	Ovate	Acute leaflet	Glabraus	Wavi leaf margen
DCP-13	DarkGreen	Ovate	Acute leaflet	Glabraus	Wavi leaf margen

Stem and flower characters

Plant habit

Based on this trait genotypes showed erect growth habit, semi-spreading growth habit and spreading growth habit. The grouping of various cowpea genotypes on the basis of plant habit basis has been presented in Table 2.

Stem colour

On the basis of stem colour genotypes were classified into following three groups:

Green ,Semi purple ,Purple.The details of these genotypes have been presented in Table 2.

Stem hairiness.

The stems were observed visually for hairiness. The genotypes, were classified as sparsly hairy, non hairy and hairy. The detailed result has been shown in Table 2.

Plant height (cm)

On the basis of plant height the genotypes were classified into three groups. genotypes had plant heights (>65cm) which were grouped as tall and three genotypes were found in medium group (55-65cm) while remaining nine genotypes were grouped as dwarf (<55cm). The results have been given in Table.2.

Flower characters

Flower colour

On the basis of flower colour three groups were made. genotypes showed white flower, light purple and purple flower colour. The detailed result has been shown in Table 2.

Days to 50 per cent flowering

On the basis of this trait genotypes showed early flowering (<35 days) , medium (35-40days) and late flowering (>40 days) respectively. The detailed result has been depicted in Table 2.

Table 2: Morphological Characters of shoot and flower of cowpea genotypes

Genotype	Plant habit	Stem colour	Stem hairiness	Plant height	Flower colour	Days of 50% Flowering
FS- 68	Erect	Green	Sparsely hairy	Dwarf (<55cm)	purple	EF-<35
Chirodi	Erect	Green	Hairy	Dwarf (<55cm)	purple	MF 35-40
GC-121	spreading	Semi purple	Hairy	Tall (>65cm)	white	MF 35-40
GC-115	spreading	Semi purple	hairy	Tall (>65cm)	purple	MF 35-40
GC-27	spreading	purple	hairy	Dewarf (<55cm)	white	EF-<35
CPD-72	Semi spreading	purple	hairy	Tall (>65cm)	white	MF 35-40
DCP-13	Erect	Green	Non hairy	Tall (>65cm)	white	Leaf -40 days

Pod characters

Immature pod colour

Based on this character genotypes were grouped into light green , dark green with purple splashes and green colour. The detailed result has been shown in Table 3.

Pod shape

Based on pod shape three genotypes erect shape and crescent shape. The detailed result has been given in Table3.

Number of clusters per plant

Based on the number of clusters per plant the genotypes were grouped into high, medium and low number of clusters per plant. The characterization of various cowpea genotypes on the basis of number of clusters per plant has been depicted in Table 3.

Number of pods per plant

Three main groups were formed on the basis of number of pods per plant as low, medium and high. genotypes, were observed having high number of pods (>20), medium group (15 to 20) and low number of pods (<15). The detailed of result has been given in Table 3.

Pod length (cm)

In this character, only two groups were formed on the basis of pod length as long and medium. No genotypes fall under small pod length. long (>10cm) and medium (8-10cm). The detailed result has been shown in Table 3.

Days to maturity

Based on time taken to reach at 80% physiological maturity of pods, the some genotypes took less than 75 days to mature and were grouped as early maturing where as some genotypes categorized as late maturing type which took more than 80 days to mature . The detailed result has been given in Table 3.

Mature pod colour

Based on this trait genotypes were grouped under yellow-colour and brown colour. The detailed result has been shown in Table 3.

Table 3: Morphological Characters of seed pod of cowpea genotypes

Genotype	Immature pod colour	Pod shape	Number of cluster per plant	No of pod per plant	Pod lenth(cm)	Days to maturity	Mature pod colour
FS- 68	green	Erect	Low(<9.0)	Medium (15-20)	Medium(8-10)	Early maturity (<75	Brown
Chirodi	green	Erect	Low(<9.0)	Low(<15)	Medium(8-10)	Early maturity (<75)	Brown
GC-121	green	Crescent	Medium(9-11)	Medium (15-20)	Long (>10cm)	Late maturity (>75)	Brown
GC-115	Dark green with purple splashes	Crescent	Medium(9-11)	Medium (15-20)	Long(>10)	Medium maturity (75-80)	yellow
GC-27	green	Erect	Medium (9-11)	Medium (15-20)	Medium(8-10)	Early maturity (<75	Brown
CPD-72	Light green	Crescent	High (>11)	High (>20)	Long(8-10)	Late maturity (>80)	yellow
DCP-13	green	Erect	Medium (9-11)	Medium (15-20)	Medium(8-10)	Medium maturity (75-80)	Brown

Seed characters

Seed coat colour

On the basis of seed coat colour genotypes were grouped under buff colour, brown colour and black colour categories. The detailed result has been given in Table 4.

Seed shape

The characterization of various cowpea genotypes on the basis of seed shape has been shown in Table 4

Rhomboid , ovoid and Kidney seed shape.

Seed crowding

Based on the compression of the seed ends the genotypes were classified into crowded and semi-crowding. genotypes were recorded as semi-crowding and crowded. The detailed result has been shown in Table 4.

Eye pattern

Based on the eye colour which surrounds white hilum the genotypes were characterized as brown small eye, brown medium eye and black large eye and brown small eye, The results for this trait is given in Table 4.

Seed yield per plant (g)

Based on the seed yield per plant, genotypes were classified as low (<7g), medium (7-10g) and high yielding (>10g). The results for categorization of genotypes on the basis of seed yield per plant are depicted in Table 4.

100-seed weight (g)

Based on the 100 seed weight, the genotype was grouped under small seeded (<7.0g) and medium seeded (7-10g) and bold seeded (>10g). The detail of 100-seed weight of different genotypes of cowpea has been presented in Table 4.

Table 4: Morphological Characters of seed shape cowpea genotypes

Genotype	Seed coat color	Seed shape	Seed crowding	Eye pattern	Seed yield per plant(g)	100 seed weight(g)
FS- 68	Around hilum	Kidney shape	Semi crowding	Brown medium eye	High (>10)	Medium seeded (7-10g)
Chirodi	brown	Rhomboid	Crowded	Brown small eye	Low (>7)	small seeded (<7g)
GC-121	Buff with out brown spot	Rhomboid	Crowded	Brown medium eye	High(>10)	Bold seeded (>10g)

Genotype	Seed coat color	Seed shape	Seed crowding	Eye pattern	Seed yield per plant(g)	100 seed weight(g)
GC-115	Buff with out brown spot	Rhomboid	Crowded	Black large eye	Low (>7g)	Bold seeded (>10g)
GC-27	Around hilum	Rhomboid	Crowded	Brown medium eye	Medium (7-10g)	Medium seeded (7-10g)
CPD-72	Buff without brown spot	Rhomboid	Semi Crowded	Brown medium eye	Medium (7-10g)	Bold seeded (>10g)
DCP-13		Rhomboid	Crowded	Brown medium eye	Medium (7-10g)	Medium seeded (7-10g)

Discussion

Genotype characterization is becoming exceedingly important in the operation of modern crop production. The ability to discriminate between and identify genotypes of agricultural and horticultural crops is fundamental for the smooth operation of modern seed trade industry. Therefore, genotype characterization or varietal purity testing is an integral part of seed quality evaluation and control. Traditionally, genotype identification has been accomplished through use of accurate records and combination of field plot methods. However, the proliferation of newly developed cultivars, has increasingly taxed a number of discriminating morphological, physiological and biochemical traits used to characterize the cultivars. An identifying character should show discontinuous variability which is more stable, but the variability in such characters is low. For classification of large number of genotypes, greater emphasis has to be placed on a combination of various quantitative and qualitative characters, there is no single criteria to identify a large number of genotypes of even same region. It requires a large number of morphological parameter to identify various genotypes. In this study, an attempt was made to characterize eight cowpea genotypes based on traditional approach . The traditional (taxonomic) approach involved the detailed observations of seeds and growing plants and recording of a range of morphological characters. In practice, this is an extremely successful process largely forming the basis for the development of procedures for Distinctness, Uniformity and Stability (DUS) testing of new as well as extant cultivars. The morphological characters of cowpea such as leaf colour, terminal leaflet shape, leaf apex, leaf surface, leaf margin, plant habit, stem colour, stem hairiness, plant height, flower colour, days to 50 per cent flowering, immature pod colour, pod shape, number of clusters per plant, number of pods per plant, pod length, days to maturity and mature pod colour were recorded .On the basis of leaf colour, the genotypes were classified into three groups i.e. green, light green and dark green. Majority of the genotypes showed green and dark green clolour . Milan and Hossain (1973) proposed that dark green leaves were having good response to high doses of nitrogenous fertilizers which were helpful in producing high yield. Leaf colour is also used by Kumar (2004) for identification purpose in wheat.The study of terminal leaflet shape made it possible to club the cowpea genotypes into three groups i.e ovate, hastate and broad. All seven genotypes, three genotypes viz. GC-121, DCP-15, FS-68 have shown hastate type of terminal leaflet and remaining ffour genotypes have shown ovate terminal leaflet shape. On the basis of this character we can easily distinguish cowpea genotypes in the field. The characterization of cultivars based on leaf shape has also been reported in cotton (Prakash, 1998).Since, all the genotypes of present study were having acute leaf apex and wavy leaf margin. Therefore, these two characters for present study will not be useful for identification of cultivars. However, more number of genotypes are required to characterize them based on leaf apex and leaf margin.

The study of leaf surface made it possible to classify the cowpea genotypes into two groups i.e. glabrous and pubescent. All seven genotypes showed glabrous leaf surface. The study of stem habit made it possible to divide the cowpea genotypes into three groups namely, erect , semi-spreading and spreading. This trait was observed to be a key diagnostic character for characterization of cowpea genotypes. The similar observation on growth habit as a field parameter has been studied by Okora *et al.* (1999). The variation in growth habit in the olive was observed to be under genetic control (Claudio *et al.*, 1999) and this parameter can serve as a promising trait for genotype identification. Kumar (2004) also used this trait in wheat for characterization.On the basis of stem colour, three main groups were made i.e. green, semi-purple and purple which were having seven genotypes respectively. Parkash (1998) also characterized the cotton cultivars on the basis of stem colour. On the basis of plant height three main groups were made i.e. tall, medium and dwarf

for characterization of cowpea genotypes. Wide variation for this character was observed in the present study (25.53-100.73 cm). Rana (2006) also reported the similar results in cluster bean. For flower colour the genotypes exhibited three colours viz. white, light purple and purple. Chickpea genotypes were also grouped based on flower colour (Singh, 2001). Study on the basis of days to 50 per cent flowering made it possible to categorize the genotypes into three groups viz. early, medium and late flowering. However, the traits such as height and 50 per cent flowering cannot be considered as reliable trait for genotypes characterization because of effect of environment. Shahid-Ahmed *et al.* (2005) studied 32 genotypes of cowpea and found significant variation among the genotypes for days to 50 per cent flowering. Similar results were also reported by Singh and Verma (2002), Anbuselvam *et al.* (2000), Sharma (1999) and Rewale *et al.* (1995) in cowpea.

Based on immature pod colour, the genotypes were grouped into light green, dark green with purple splashes and green colour with three, four and fifteen genotypes, respectively in each group. Rana (2006) characterized the cluster bean genotypes into straight, sickle and curved pods. Based on number of clusters per plant, the genotypes were categorized into high, medium and low number of clusters per plant. For the character, number of pods per plant also three groups was formed as high, medium and low. These characters are not promising in characterization of present cowpea genotypes. Alam *et al.* (1994), reported similar results, as the characters such as number of clusters per plant, number of pods per plant in cross V16 x CI52 appeared to be more influenced by the environment which reflected the low estimates of heritability and genetic advance. Based on pod length, only two groups were formed i.e. long and medium. Based on days to maturity the genotypes were categorized into early maturing, medium and late maturing genotypes. The similar results were also reported by Omoigui et al. (2006) for pod length, days to maturity in cowpea. Based on mature pod colour, the genotypes were divided into yellow and brown colour. Eight genotypes exhibited under yellow and remaining fourteen genotypes showed brown colour of pods, Magloire (2005) characterized African cowpea genotypes based on growth pattern, plant pigmentation, terminal leaflet shape, plant hairiness, flower colour and immature pod pigmentation.

Based on the seed coat colour the genotypes were classified into buff colour, brown, and black. The study on seed shape made it possible to classify the cowpea genotypes into three classes viz. rhomboid ovoid kidney shape . Chakrabarty and Agrawal (1989) examined the 16 black gram varieties based on seed colour (black or brown) and seed surface (Shiny or dull).

Agrawal and Pawar (1990) evaluated the soyabean varieties based on the seed morphological characters, namely seed size, seed coat colour and hilum colour. Similar studies were conducted by Nethra *et al.* (2005) in rice, Rana (2006) in cluster bean. Based on seed crowding, the genotypes were categorized into two groups i.e. crowded and semi-crowding.The character eye pattern was used to characterize the genotypes into brown small eye, brown medium eye and black large eye. But to use seed shape, seed crowding and eye pattern in genotype characterization, extensive studies are required.Based on the seed yield per plant three classes were made i.e. high, medium and low yielding. Based on the 100-seed weight the genotypes were classified as bold seeded, medium seeded and small seeded. Omoigui *et al.* (2006) studied genetic variability for seed yield per plant and 100-seed weight in cowpea. A number of workers studied these characters for variability in cowpea. Worth mentioning among those were, Anbuselvam *et al.* (2000), Iqbal *et al.* (2003) and Sahid-Ahmed *et al.* (2005).Based on variation observed for diagnostic characters at field level for characterization of cowpea genotypes . According to key characters, such as seed crowding, seed shape, eye pattern, plant habit, terminal leaflet shape, leaf surface, flower colour, stem colour, immature pod colour, mature pod colour were used to distinguish the genotypes.

Conclusions

Morphological characters were studied by using different diagnostic characters namely seed crowding, seed shape, eye pattern, plant habit, terminal leaflet shape, flower colour, stem colour, immature pod colour, pod shape and mature pod colour. These characters were used to provide basis for identification, without the requirement of costly chemicals and are fairly comparable in their results, having abundant variability which could satisfactorily distinguish the genotypes.

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